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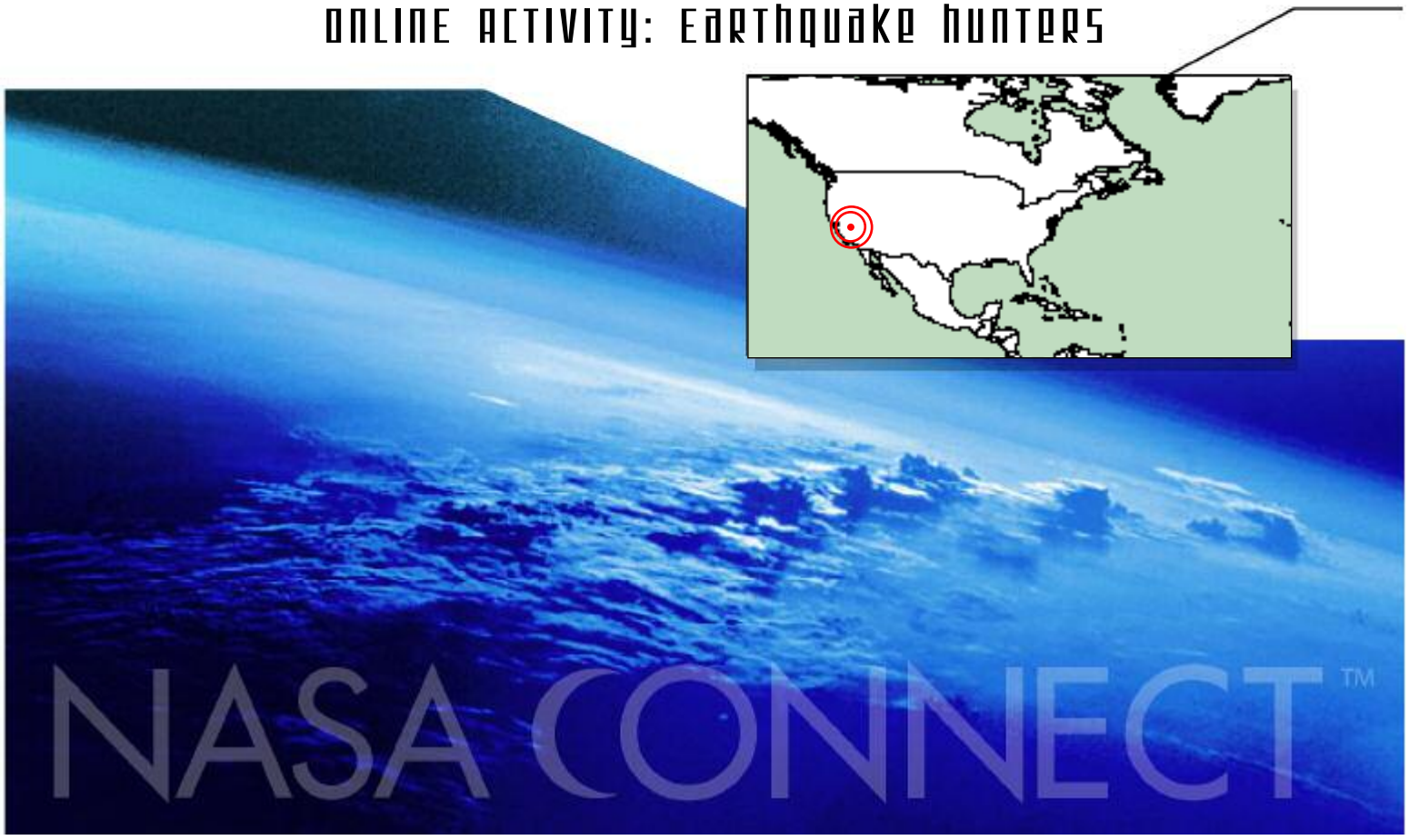
NASA CONNECT™

VIRTUAL EARTH

An Educator Guide with Activities in Mathematics, Science, and Technology

ONLINE ACTIVITY: EARTHQUAKE HUNTERS



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A PDF version of the educator guide for NASA CONNECT™ can be found at the NASA CONNECT™ web site: **http://connect.larc.nasa.gov**

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NASA CONNECT™

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ONLINE ACTIVITY: EARTHQUAKE HUNTERS

Program Overview

Online Activity

Student Handout

Teacher Handout

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PROGRAM OVERVIEW

INTRODUCTION

NASA and its partners, FEMA, NOAA, and USGS band together to study the very important phenomenon called earthquakes. Data from the NASA satellite missions are used to create geospatial models that help their partners build decision and support tools to monitor earthquakes and their associated disasters.

http://www.earth.nasa.gov/eseapps

http://solidearth.jpl.nasa.gov/PAGES/quake04.html

http://solidearth.jpl.nasa.gov/PAGES/quake02.html

http://solidearth.jpl.nasa.gov/PAGES/pr_obs07.html

http://solidearth.jpl.nasa.gov/gess.html

This web activity will help you and your students learn more about earthquakes. To aid in your research, you'll be using the power of an Internet-based GIS (geographic information system). With it you'll be able to navigate around the map, change focus, display new layers, and ask questions of the data. If you'd like to learn more about this important technology, visit *www. gis.com*.

Note: Earthquake Hunters is an Internet extension activity based on a lesson, The Earth Moves, from the GIS workbook and software package from ESRI Press, Mapping Our World: GIS Lessons for Educators. If you are interested in finding out more, go to *www.gisetc.com/nasa*.

INSTRUCTIONAL OBJECTIVES

The student will

- locate zones of significant earthquake activity around the world.
- describe the relationship between zones of high earthquake activity and the location of tectonic plate boundaries.
- identify the most densely populated areas in the world that are most at risk for seismic disasters.

NATIONAL STANDARDS

National Science Standards

Unifying concepts and processes in science

- Evidence, models, and explanation

Science as inquiry

- Abilities necessary to do scientific inquiry

Earth and space science

- Structure of the Earth system

Science and technology

- Abilities of technological design

National Geography Standards

- The student understands how to make and use maps, globes, graphs, charts, models, and databases to analyze spatial distributions and patterns.
- The student understands how to predict the consequences of physical processes on Earth's surface.
- The student understands how the interaction of physical and human systems may shape present and future conditions on Earth.

ONLINE ACTIVITY

PREPARING FOR THE ACTIVITY

Student Materials

- blank world map
- student directions
- Earthquake Hunters Student Handout
- pencil
- color marker

Teacher Materials

- Earthquake Hunters Answer Key

Time for Activity

45 minutes

Advance Teacher Preparation

Print out a copy of the blank world map, student directions, and Earthquake Hunters Student Handout for each student.

THE ACTIVITY

Student Directions

You might think that NASA focuses its attentions solely toward the skies. Actually, NASA has a very important satellite system called the Global Earthquake Satellite System (GESS) that is very much concerned with tectonic activity on Earth's surface.

Have you ever seen news coverage of a major earthquake that has just happened? Wouldn't it be nice if scientists could predict earthquakes before they happened? Well, that is what NASA's GESS satellite has as its goal! Someday, GESS will be able to forecast information about Earth's surface and its tectonic activity BEFORE earthquakes happen so that many lives can be saved.

Let's step into the shoes of the scientists who study information from GESS and take a look at the tectonic activity on Earth and what GESS and NASA are studying! Can you forecast where the next earthquakes will happen?

1. Before you start the web activity, can you determine where earthquakes take place?
   On your blank world map, use a pencil to indicate where you think earthquakes take place in the world.
2. Go to the Earthquake Hunters web site, *http://digitalquest.com/spacestars/earthquakes.htm*.
3. On the right-hand side of the world map under the title "Layers", there are two columns of boxes and radio buttons (circles), one titled "Visible" and the other titled "Active". A check mark is in the "Visible" box next to "Countries". There is also a dot in the "Active" radio button next to "Large Cities".
4. Click on the "Active" radio button next to "Countries". Clicking on the "Active" radio button will let you look at information in that map layer instead of the "Large Cities" layer that was active before. On the left side of the world map, there are various buttons that allow you to navigate the world map and to find information about the different map layers. Click on the "Identify" button, then click on any country. If you click on a geographically small country, you may notice that many countries are identified and it is difficult to tell which country is which. Continue to the next step to learn how to identify only one geographically small country.

5. On the left side of the world map, click on the "Zoom In" button and then click and drag a box around a country you would like to identify. Use the "Identify" button to identify a geographically small country. What is displayed on your screen?

6. Click on the "Zoom to Full Extent" button to display the entire map.

7. Click on the "Visible" box and the "Active" radio button next to "2003 Earthquakes > 4.5 mag." layer. Click on the "Refresh Map" button. The map you see displays the earthquakes that have occurred so far in 2003 that have a magnitude greater than 4.5 on the Richter scale. (Remember, clicking on the "Active" radio button will let you look at information in that earthquake layer instead of the country layer that was active before.) Do you know what a Richter scale is? If not, click on the link if you would like more information about the Richter scale: *http://neic.usgs.gov/neis/general/handouts/richter.html*
8. Using the "Zoom In" button you learned about in step 5, click and drag a box around a cluster of earthquakes so that you can see the individual earthquakes.
9. Use the "Identify" button to find out information for one earthquake. Zoom in until you can identify one earthquake. Write in the information you find out about the earthquake in the chart on your Student Handout.

Rec	YEAR	MONTH	DAY	TIME_HHMMS	LATITUDE	LONGITUDE	MAGNITUDE	DEPTH	#SHAPE#	#ID#

Questions:

a. Which field in your chart indicates how large an earthquake is?

b. How large is the earthquake you chose?

c. What year, month, and day did the earthquake occur?

10. Now click on the "Visible" box next to the "2002 Earthquakes > 4.5 mag." layer. Click on the "Refresh Map" button. To see the entire world map, remember to click on the "Zoom to Full Extent" button. The earthquakes from 2002 and 2003 seem to have a pattern. Using your color marker, draw the pattern on your paper map.

Question:

Did the earthquakes you predicted on your paper map coincide with the pattern you drew? Explain how.

11. Click on the "Visible" box next to the "Plates" layer and refresh map.

Question:

What can you say about the earthquakes in 2002 and 2003 and the tectonic plates? (If the boundaries of the plates are hidden, you can turn the "Plate Boundaries" layer on and off to get a better look at them while the earthquakes are displayed.)

In the next section, let's look at cities and earthquakes.

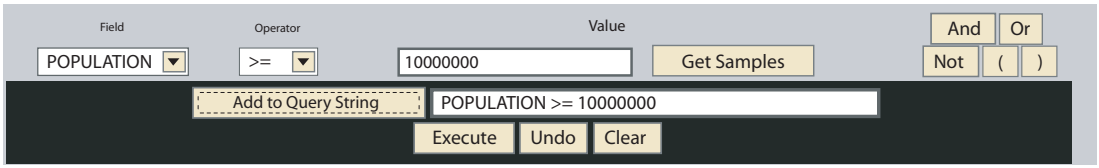
12. To stop displaying these layers, click on the "Visible" box in the following layers:

- "Countries"
- "2002 Earthquakes > 4.5 mag."
- "2003 Earthquakes > 4.5 mag."

Then click on the "Refresh Map" button to stop displaying the countries and earthquakes on your world map. Click on the "Visible" box and "Active" radio button next to the "Large Cities" layer. Click on the "Refresh Map" button to display the "Large Cities" layer.

This layer displays cities that have populations of greater than or equal to 500,000. To study the effect earthquakes have on large population centers, it would help to be able to look at some of the world's largest cities that lie on plate boundaries. To do that, we can query or ask questions of the computer about the cities that lie on plate boundaries.

13. Click on the Query Button. Fill in the "Field", "Operator", and "Value" boxes as shown in the picture below.



Click on "Add to Query String." Now click the "Execute Button."

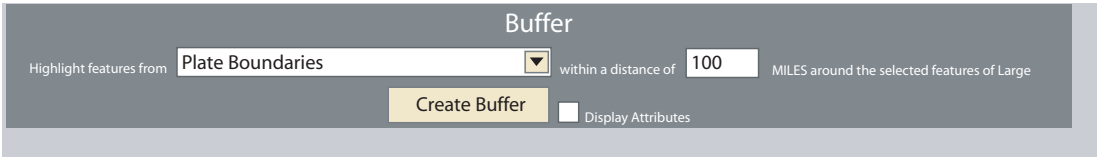
Questions:

a. What has changed on your map?

b. What do those changes signify?

c. How many world cities have populations greater than or equal to 10,000,000?

14. With the Cities you queried from Step 13 still highlighted, click on the "Buffer" tool. Replace "No Layer" with "Plate Boundaries" and complete "within a distance of" with "100." Be sure your screen looks like the picture. Make sure to read the entire Buffer "sentence" you created to understand what you are doing. (Highlight features from Plate Boundaries within a distance of 100 miles around the selected features of "Large Cities.")



Click on Create Buffer.

Question:

What has changed on your map?

15. To see all the changes that occurred when you completed your buffers, click on the "Zoom In" button and zoom into one of your highlighted cities.

Questions:

a. What has the buffer tool done to your highlighted cities?

b. What do you think the circles around the highlighted cities mean?

16. With the observations you made from Steps 14 and 15, list the cities that have populations of greater than or equal to 10,000,000 and that lie within 100 miles of a plate boundary. (Remember you can zoom in and out of the highlighted cities and plate boundaries as you look for a solution.)

List City (Cities):

Questions:

a. How many people could potentially be affected in those cities?

Now that you have completed this introductory earthquake activity,

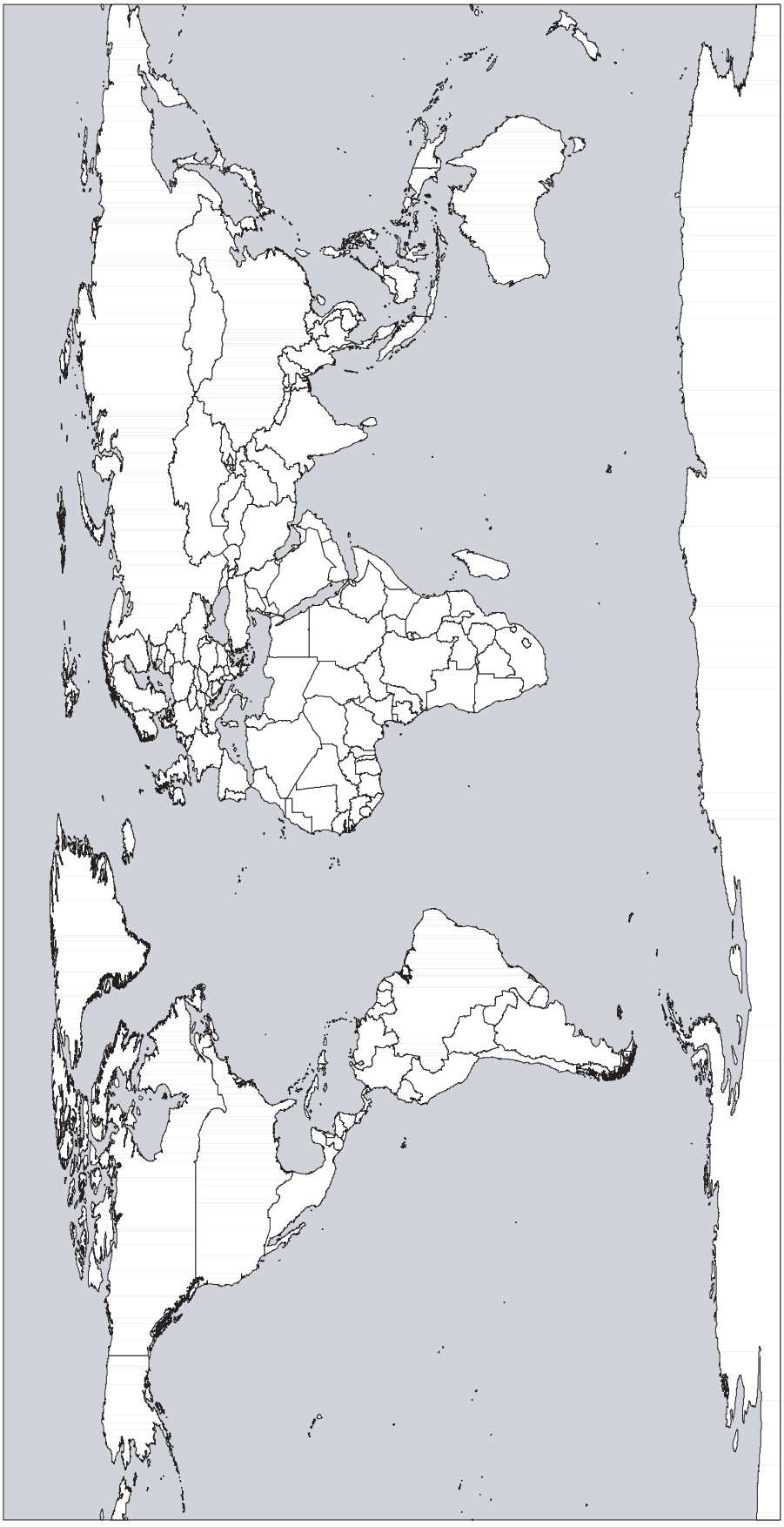
b. Do you think it's important for NASA to study tectonic activity? Why?

c. Why do you think so many people live in regions where there is a high level of tectonic activity?

Using the tools you have learned in this exercise, continue to sharpen your skills as an Earthquake Hunter by conducting further research. You might be surprised with what you find!

STUDENT HANDOUT

BLANK WORLD MAP



Earthquake Hunters

Student Handout

Directions: *Answer the following questions based on the Earthquake Hunters web activity. The questions are also given in your direction handout. The question number corresponds to the step number in the directions.*

9.

Rec	YEAR	MONTH	DAY	TIME_HHMMS	LATITUDE	LONGITUDE	MAGNITUDE	DEPTH	#SHAPE#	#ID#

a. Which field in your chart indicates how large an earthquake is?

b. How large is the earthquake you chose?

c. What year, month, and day did the earthquake occur?

10. Did the earthquakes you predicted on your paper map coincide with the pattern you drew? Explain how.

11. What can you say about the earthquakes in 2002 and 2003 and the tectonic plates?

13. a. What has changed on your map?

b. What do those changes signify?

c. How many world cities have populations greater than or equal to 10,000,000?

14. What has changed on your map?

earthquake hunters
student handout

15. a. What has the buffer tool done to your highlighted cities?

b. What do you think the circles around the highlighted cities mean?

16. With the observations you made from Steps 14 and 15, list the cities that have populations of greater than or equal to 10,000,000 and that lie within 100 miles of a plate boundary.

List City (Cities):

a. How many people could potentially be affected in those cities?

b. Do you think it's important for NASA to study tectonic activity? Why?

c. Why do you think so many people live in regions where there is a high level of tectonic activity?

Earthquake Hunters

Teacher Handout: Answer Key

Directions: *Answer the following questions based on the Earthquake Hunters web activity. The questions are also given in your direction handout. The question number corresponds to the step number in the directions.*

9. *The information in the chart will change, depending on which earthquake the students choose; however, it should look similar to the example.*

Rec	YEAR	MONTH	DAY	TIME_HHMMS	LATITUDE	LONGITUDE	MAGNITUDE	DEPTH	#SHAPE#	#ID#
1	2003	4	17	010419	39.52	-111.86	4.7	0	(point)	1317

a. Which field in your chart indicates how large an earthquake is?
Magnitude

b. How large is the earthquake you chose?
For this earthquake the answer is 4.7

c. What year, month, and day did the earthquake occur?
For this earthquake the answer is April 17, 2003.

10. Did the earthquakes you predicted on your paper map coincide with the pattern you drew? Explain how.

The answer will vary for this question based on the students' knowledge of earthquakes in the news or from class or if they have already studied tectonic activity.

11. What can you say about the earthquakes in 2002 and 2003 and the tectonic plates?

Students' answers will vary slightly but should include that most quakes seem to happen on tectonic plate boundaries. They may also observe that even though plate boundaries seem to have a major effect on earthquake activity, there are also major zones of earthquake activity that don't appear to be at all near a plate boundary, i.e., Europe, Asia, the United States.

13. a. What has changed on your map?
Some of the cities have yellow dots on them.

b. What do those changes signify?
These are the cities that have populations greater than or equal to 10,000,000.

c. How many world cities have populations greater than or equal to 10,000,000?
Eleven

14. What has changed on your map?
One of the plate boundaries in Asia turned red.

earthquake hunters

teacher handout: answer key

15. a. What has the buffer tool done to your highlighted cities?
There are circles around the cities.

b. What do you think the circles around the highlighted cities mean?
The circles are the 100-mile radii that were entered with the buffer tool.

16. With the observations you made from Steps 14 and 15, list the cities that have populations of greater than or equal to 10,000,000 and that lie within 100 miles of a plate boundary.

List City (Cities): *Tokyo*

a. How many people could potentially be affected in those cities?
23,620,000

b. Do you think it's important for NASA to study tectonic activity? Why?

c. Why do you think so many people live in regions where there is a high level of tectonic activity?
Answers will vary. This question is a great starter question for further classroom discussion and independent research.